MULTIPLEX APPROPRIATION IN COMPLEX SYSTEMS IMPLEMENTATION: THE CASE OF BRAZIL'S CORRESPONDENT BANKING SYSTEM[1]

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*When user needs do not align with system designers' visions, new technology implementation becomes a complex process as users appropriate the new technology to meet their needs. Prior studies recognize this complexity, but focus on the complex implementation of simple systems in which user groups are well defined and the IT artifact is the primary change. We extend the research lens by examining the implementation of the Brazilian correspondent banking system, a complex system involving multiple actors, system elements, and settings intended to address the social problem of financial exclusion. Our case study comparison of two settings—retail stores and post offices—reveals that actors' appropriations extended beyond the IT artifact to include technical, role, usage, social, and policy appropriations. The intended users (poor clients in remote and underserved areas) barely interacted with the IT artifact or other system elements; instead, they relied upon remote bankers (correspondents) to appropriate the system on their behalf. Because rewards, incentives, and constraints differed by setting, correspondents' appropriations differed by setting. We call the resulting mix of appropriations across multiple elements by multiple actors in multiple settings **multiplex appropriation**. Complex societal challenges often involve multiple users in multiple settings with varied needs and few technology skills; thus, designing systems to meet user requirements may prove impossible. Instead, allowing multiplex appropriation might foster system success because, rather than forcing a global alignment among system elements or trying to ascertain multiple user needs, it allows for multiple local alignments of system elements that fit local settings.*

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Introduction

Implementing information systems is a complex process when user needs do not align with the visions of system designers. In such cases, users must appropriate new technology by adapting it to meet their needs, which may or may not match designers' goals (Leonardi and Barley 2008; Orlikowski 1992; Poole and DeSanctis 1990). Studies adopting adaptive structuration theory (AST) have envisioned the complex process of systems implementation as a normal state of affairs, rather than an infrequent occurrence, and have highlighted the important role that user appropriations play in explaining successful outcomes (DeSanctis and Poole 1994; Markus and Silver 2008). To align a technology's features with their needs, users typically make various appropriations of the new technology until they collectively settle on a pattern of use, resulting in a stabilized system over time (Leonardi 2013; Majchrzak et al. 2000; Tyre and Orlikowski 1994). But whereas most studies of system implementation, including those using AST, have examined implementation as a complex process, they have tended to focus on systems that are relatively simple (Rice and Leonardi 2013). A simple system has well-defined user groups (i.e., users who work in a single organization or across several organizations that are closely aligned) and an environment in which introduction of the IT artifact is the primary change.

Our interest in this paper is in extending the research lens of IS studies of appropriation from a focus on the complex process of implementing simple systems, to explain how implementation unfolds when systems are, themselves, complex. In general, complex systems are characterized by multiple elements with various degrees of freedom, multiple interactions occurring among those elements, multiple actors playing multiple roles, and distribution across multiple settings (Eisenhardt and Piezunka 2011, pp. 508-509). In the context of information systems, a focus on complex systems would extend beyond the user–artifact relationship in a single setting to complex systems implemented in multiple settings, with multiple actors beyond users and multiple elements beyond the IT artifact (Bødker and Andersen, 2005). For example, although appropriation studies have looked a bit beyond users by considering the role of technology mediators who model use of the IT artifact for users (e.g., Orlikowski et al. 1995; Volkoff et al. 2007), they have not considered mediators as surrogates who may use the system on behalf of actors. More broadly, most studies of user appropriation have occurred in contexts in which well-defined user groups work

within a single organization (Leonardi 2007; Oborn et al. 2011) or across organizations as virtual teams (Berente et al. 2010; Majchrzak et al. 2000). However, not all actors in a system may be as homogenous in their intentions and actions as these groups as a result of different roles within the system. Some appropriation studies have begun to examine groups that are not so well defined. Studies of system implementation in developing countries, for example, have shown how different groups of users appropriate new technology in ways that vary by the groups' cultures, goals, and values (Walsham 2002; Walsham and Sahay 1999). Researchers find it difficult to explain why different types of actors make the appropriations they do in developing countries (Walsham et al. 2007), a failing that persists for the broader literature as well (Leonardi and Barley 2010).

The IT artifact itself is just one element of the system that interacts with other elements including policies, organizations, and institutions, all of which have features actors might appropriate. Recognizing this larger ecosystem surrounding IT implementation, DeSanctis and Poole (1994) proposed in their formulation of adaptive structuration theory that actors could appropriate the technology, the group structure, or the organizational environment when learning to use a new technology. However, the authors later acknowledged that adaptive structuration theory has had a hard time explaining when and why actors appropriate these other elements (Poole and DeSanctis 2004), and few studies using adaptive structuration theory have included the full scope of an ecosystem in their examinations of appropriation (for a notable exception, see Majchrzak et al. 2000).

To pursue the idea of the larger ecosystem in studies of user appropriation—to enfold multiple actors, multiple system elements, and multiple settings in the research lens—we pose this research question: *How and why do multiple actors in a complex system make (possibly different) appropriations of the system's elements*? The answers to this question should provide insight into the conditions under which complex systems are implemented in multiple settings, highlight the interconnectedness of appropriations across settings, and begin to tease out actors' intentions in making appropriations in complex systems.

We explore our question through a qualitative study of the ecosystem surrounding the implementation of a new banking system in Brazil whose multiple actors, system elements, and settings provided ample and varied opportunities for appro-

priation. The new banking system arose to overcome the social problem of financial exclusion in which people lacked ease of access to and usage of a country's formal financial system (Sarma and Pais 2011). Because financial exclusion is often a harbinger of social exclusion and poverty, an inclusive financial system is preferred. According to Alves and Soares (2006, p. 87), in 2001, more than one quarter of the cities in Brazil had no banking facility. As the federal government had created a new welfare payment to be delivered to the poor through the banking system, many recipients incurred great hardship in collecting their payments (Licio et al. 2011). For example, in remote areas of the Amazon, picking up a monthly government check could consume two full days as people traveled by boat from small towns to larger cities with banks.

To reduce this hardship, the government mandated in 2001 that all welfare recipients receive their payments where they live (Alves and Soares 2006). This mandate presented Caixa Econômica (hereafter, Caixa), the public bank responsible for the payments, with a logistical and economic predicament: providing payments across Brazil's vast countryside at reasonable cost. Establishing new branches or ATMs in remote areas would be too expensive; ATMs had the additional problem of being difficult to use by low-literate, technologically inexperienced clients (Diniz et al. 2008; Ivatury 2006). Thus, Brazil's Central Bank designed a new banking channel, called the correspondent banking system, to promote financial inclusion. The correspondent banking system is a legal framework within which banks provided financial services to the poor and underserved by partnering with retail stores and other outlets (Kumar et al. 2006). The system operates by contracting workers at these outlets to become banking "correspondents" (local bankers), enabling them to distribute welfare checks, collect bill payments, and provide basic banking services (Jayo et al. 2012).

This new banking system is more complex than most systems featured in IS studies of user appropriation. To begin with, the intended users were poor clients who barely interacted with the IT artifact. Correspondents were meant simply to enable users' transactions, but they came to act as technology mediators who appropriated the IT artifact on behalf of their clients. Thus, the user group was not homogeneous; in fact, correspondents' intentions and actions further varied by their organizational and institutional settings. Moreover, the IT artifact was but one element in the ecosystem of correspondent banking. Government policies, specified roles, banking procedures, and organizations and institutions such as grocery shops and post offices were other elements; each of these elements interacted with one another and each was, like the IT artifact, ripe for user appropriation.

We term the resulting mix of system enactment across settings *multiplex appropriation* to capture the idea of multiple appropriations to multiple elements by multiple actors across multiple settings in this complex system. We explore the implications of our findings for research on complex system implementation in developing countries, specifically, and in the IS field more broadly.

Research Method

Research Context

The correspondent banking system combined (1) the IT artifact and supporting ICT infrastructure, (2) multiple actors of varying types, and (3) policies to enable nonfinancial outlets to provide banking services (Alves and Soares 2006). We describe each system element in turn.

The IT artifact consisted of a point-of-service (POS) device or personal computer (PC) to select transaction types; a barcode reader; a client card reader; and a keypad for clients to enter personal identification numbers (PINs). The IT artifact was simple and rigid. Simple IT required only a local inventory of inexpensive parts and low-skilled technicians, thereby avoiding costly repairs to sophisticated equipment in remote locations (Jayo et al. 2012). Rigidity was the result of security concerns: banking systems by design typically disallow user alteration (Hertzum et al. 2007). Supporting ICT infrastructure connected the POS or PC to bank servers via dial-up Internet, General Packet Radio Service, or satellite.

Beyond the technology, as Figure 1 shows, the ecosystem of correspondent banking involved multiple actors. *Clients*—Brazilians who received government welfare assistance—were the intended users of the new banking system. Designers meant for clients to interact with the IT artifact by sliding their system card through the reader, typing in their PIN, expressing their desired service to the correspondent, and producing necessary documents (e.g., a utility bill). Owners and employees at lottery shops, community banks, retail stores, and post offices could be *correspondents*. Designers intended for correspondents' interactions to be limited to certain features of the IT artifact. After clients had swiped cards and entered PINs, the correspondent was meant to select services on the interface (such as "bill payment"), enter monetary amounts, scan documents (e.g., a utility bill's bar code), handle cash, and provide receipts. *Network integrators* were third parties who provided technology, training, and support to correspondents. *Banks* provided clients with accounts, facilitated benefit distribution, and provided the banking software. The government, via the Ministry of Social Development, sponsored the welfare benefit program, issued
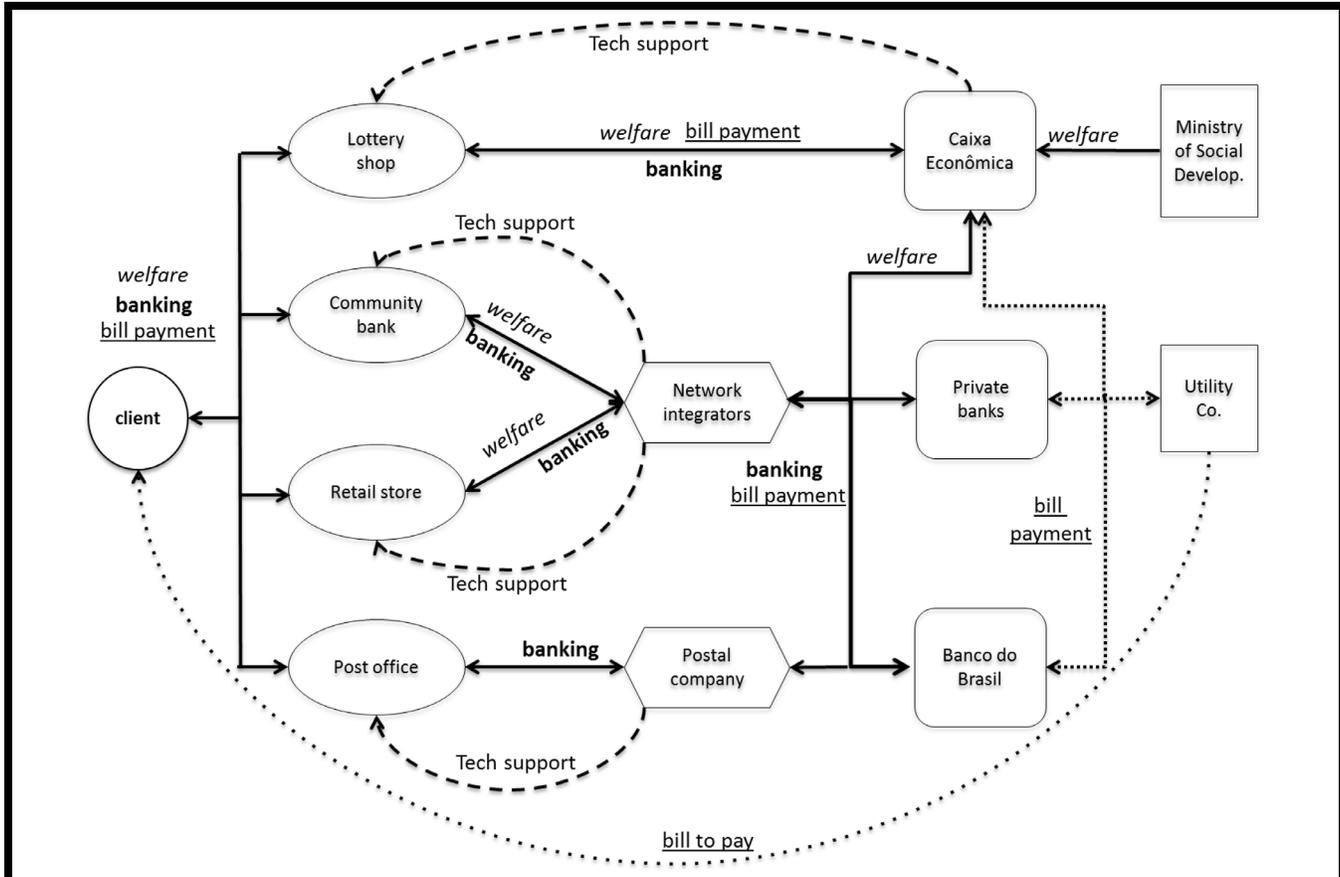
Figure 1. Selected Ecosystem of the Brazilian Correspondent Banking System

the clients' system cards, and regulated the banking market through the Central Bank. Last were *utility companies*, whose bills clients could pay at the correspondent (Jayo et al. 2012).

Several policies governed this system. Central Bank regulation restricted the services that correspondents could offer; for example, correspondents could collect—but not approve—loan applications. Because correspondents lacked armed security, bank policy limited how much cash they could keep on hand. When the correspondent's cash reached the limit, the system software automatically turned off, forcing the correspondent to deposit cash at the bank before continuing with transactions. Such policies provided the rules by which the new banking system operated.

Today, more than 150,000 correspondent outlets operate across Brazil, far surpassing the number of regular bank branches and ATMs (Banco Central do Brasil 2011). These outlets have significantly reduced financial exclusion; as Feltrim et al. (2009, p. 18) noted, "since 2002, there is no Brazilian city without access to financial services, due to the

correspondents' expansion." Of the 12 million primary welfare program benefits (one per family) cashed in May 2010, 70% were cashed at a correspondent (Banco Central do Brasil 2011). Correspondents serve an estimated 16 million poor families and handle 60% of all utility payments nationwide (Sanford and Cojocaru 2013). The system has garnered worldwide acclaim: "What happens next in Brazil when it comes to correspondent banking will serve as a considerable source of learning for the rest of the world" (CGAP 2011, p. 4).

Research Design

We followed a case study methodology (Yin 2014), in which settings formed the relevant cases. A setting consisted of a correspondent, his clientele, his place of business and its contents (e.g., his store), his employees, the banking IT artifact as well as technology for the primary business, his bank partner, and any third party network integrators affiliated with him. Although, as Figure 1 makes clear, there are at least four

settings in which correspondent banking is carried out—lottery shops, community banks, retail stores, and post offices—we report in this paper only two settings: retail stores and post offices. Following strategies for comparative analysis (Barley 1996), we chose settings in which actors performed the same work in different structural and cultural environments. The analytic logic was to increase the robustness of findings by uncovering similar intentions and actions across the different settings (Bechky and Okhuysen 2011). We choose retail stores and post offices because they differed structurally in whether correspondent banking was mandated or voluntary. Post office workers had no choice but to work as correspondents, while retail storeowners could opt in or not. The settings differed culturally in that most post offices were in urban or semi-urban locations, while retail stores were primarily in semi-urban and rural areas. Following Benbasat et al. (1987), by opting to compare settings in which differences were pronounced, we could include these structural and cultural features as controls in our cross-case analysis.

Data Collection and Analysis

We built our case studies upon primary and secondary data. The primary data were interviews with system actors in a variety of roles. Because we interviewed almost all informants at their workplaces, we could informally observe their banking and business processes. These informal observations contributed to our ability to understand the implementation context and provided background for the material related in interviews. Semi-structured interviews ranged from 20 minutes to 2 hours, with a median of 1 hour. We audio recorded interviews and wrote notes to capture such factors as the physical layout, clientele, IT artifact, and user actions. We conducted interviews in October 2011 and March 2012.

Table 1 shows the distribution of our interviews and sample interview questions. We interviewed all actors depicted in Figure 1 except groups on the periphery. We did no interviews at utility companies or the Ministry of Social Development because our focus was on appropriations made by actors who had direct contact with the IT artifact within this complex system. Although clients had such contact, our stays were too short to build enough trust with the local population to interview them. Because our informants and our informal observations confirmed that clients' interaction with the IT artifact was minimal, and their appropriation of other system elements negligible, this gap did not impair our findings. We interviewed *bancarios* (individuals who worked in various traditional, formal positions within banks—from tellers to vice presidents) because comparing correspondents with them revealed the extent to which user appropriation was unique to the new, and not the old, banking system.

We reviewed secondary data in the form of articles written about correspondent banking in Brazil as well as archival documents from our informants. We also gained extensive secondary data from our Brazilian coauthor, who tutored us based on his prior research on this system, reflected in over 30 academic publications as well as talks to (or funding from) agencies concerned with financial inclusion, including the World Bank, the Gates Foundation, and Brazil's Central Bank. This background shaped our research design and pointed to new informants when interviews raised issues we wished to explore.

Beginning with a within-case analysis (Yin 2014), we considered each setting separately. We conducted selective coding (Strauss and Corbin 1998) of our transcripts in ATLAS.ti to analyze how actors took action, and the rewards, incentives, and constraints that shaped action. We then refined our codes to identify specific intentions and actions. We uncovered several themes within settings using this axial coding (Strauss and Corbin 1998) process. For example, we identified "bureaucratic structure" as a common constraint in one setting and "appeal to pride" as a common reward in another. Next, we turned to cross-case analysis (Yin 2014), looking for differences and similarities across settings. We conducted selective coding (Strauss and Corbin 1998) to note factors that shaped how and why actors acted.

Findings

Our findings show that multiple actors appropriated the new correspondent banking system in different ways, with appropriations extending far beyond the IT artifact. Clients, the system's intended users, made few appropriations themselves, but they prompted correspondents to make appropriations on their behalf. We first provide the results of our within-case analyses, which explain user intentions and actions in retail stores and post offices. These within-case analyses help to explain how and why actors in a complex system appropriated system elements. We then present the results of our cross-case analysis to highlight how and why appropriations varied by setting, resulting in multiplex appropriation.

Retail Store Correspondents' Intentions and Actions

In the most common setting in the system, the correspondent was a grocery store owner or other small retailer, such as a pharmacist or shoe store owner. The retailer's incentive to become a correspondent was almost always economic, aimed at drawing more foot traffic into her store—people cashing

Setting/Group	Role	Establishment	Interviews	Sample Questions
Table 1. Summary of Primary Data Collection				
Retail Store Setting	Correspondent (owner/clerk)	Copy store	2	What kinds of problems do you routinely face as a correspondent? When you have that problem, what do you do? Could you show me the different technologies and tools that you use in your job as a correspondent? What problems do you have with them? When you have that problem, what do you do?
		Grocery store	7	
		Internet store	1	
		Pharmacy	1	
		Rental car outlet	1	
		Shoe store	1	
Post Office Setting	Correspondent (manager/clerk)		4	
Network Integrator	Engineer		2	How do you train correspondents on the technology? What do you cover?
System Designer	Board member and former CIO	Caixa	1	How were clients meant to use the technology? Correspondents?
Bancario	Senior manager	Banco do Brasil	1	What kinds of problems do you routinely face as a *bancario*? When you have that problem, what do you do? What did your training cover? In what ways was the training helpful? What did they forget to teach you in the training? Could you show me the different technologies and tools that you use in your job as a *bancario*? What problems do you have with them? When you have that problem, what do you do?
	Branch manager		2	
	Teller/agent		6	
	Regional manager	Caixa	1	
	Branch manager		3	
	Teller/agent		10	
	Senior manager	Private	1	
	Branch manager		3	
	Teller/agent		2	
Total Correspondents: 17		**Total Others: 32**		**Total System Actors: 49**

checks or paying bills might also pick up a loaf of bread or a carton of milk. Some retailers were initially compelled to become correspondents out of a desire to help: they knew that their community suffered without bank services, as this comment attests:

> *It was a cry for help from the population surrounding us....They told me to do something about this because they spent money going there* [to a nearby town with bank branches]. *With transportation and food, by the time they were back they had little left from their pay.* (Grocery store correspondent)

Independent of their initial incentive to become a correspondent, all retail store correspondents quickly discovered that they needed to act outside their specified role. These actions were apparent in the correspondents' use of the IT artifact. Although correspondents uniformly regarded the technology as easy to use (*"We just connect to the energy and that is it"*), clients found it difficult. In every store we visited, the keypad was not facing the client, but sat beside the correspondent. Store owners explained that, intimidated by electronic tech-

nology, clients handed over a slip of paper with their PIN written on it. The owner glanced at the slip, typed in the PIN, and returned the slip to the client. Although simple, the IT artifact proved too novel for many clients to use. This small act propelled the store owner from mere operator of the system interface to a trusted figure with whom clients shared vital, private financial information. Clients began to call upon retail store correspondents as financial advisors on many issues, such as whether they should start saving their money at the bank. Thus, retail store correspondents deepened financial inclusion even though the system had not been designed in this way.

A second example of retail store correspondents' actions concerned the banks' cash limit policies. The cash limit posed a hardship on these correspondents, especially in rural locations, because they often reached the limit when no one was available to run to a distant bank to deposit cash, and customers grew angry when correspondents could not service them. This correspondent explained how he took action by using his own account to evade a particular cash limit on the size of a single bill payment:

The [bill payment limit] *here is R$500 and the boleto* [bill] *was for R$700. That exceeded the limit, so to keep the client here, I opened a savings account in my name. I deposited money in my account and paid the bill. I was a little afraid that I could be doing this wrong.* (Grocery store correspondent)

With clients trusting retail store correspondents with their PINs and with some correspondents breaking rules to serve clients when the bank's policies specified they should not, clients' trust in correspondents grew and they began to expect additional actions from the correspondents, particularly with respect to government agencies and banks, which intimidated them. Retail store correspondents, beseeched by clients to intercede on their behalf, came to act as intermediaries to these institutions in matters beyond correspondent banking. For example, a client sometimes came to a grocery store owner to tell him that the utility company was going to turn off his electricity. Where should he go to stop them? Owners also served as mediators of local disputes, such as property fights.

In the course of carrying out banking transactions, retail store correspondents gained additional rewards, including a greater public role and higher status in their communities. One correspondent told us that his wife, who was his business partner, should run for mayor now because everyone came to her with problems. Other owners spoke of the recognition as problem solvers they now had in the community:

Here is a small town, and they expect that we know everything….Things that we cannot resolve here, I always try to find the answer for them. (Grocery store correspondent)

Bancarios did not similarly express a desire to guide or to otherwise aid poor clients. Rather, they were glad that correspondents were servicing poor clients because it left them with a higher class of customer, as this informant explained:

If a lot of people don't have a bank account, don't have access to a bank, don't have proven income, they [still] *have to pay their bills somewhere. And this public doesn't interest me….The banking correspondent takes out this load of people, leaving my branch wonderfully beautiful,* [leaving] *not only those who have money, but those who want my money* [as loans]. (Bank loan agent)

In the case of retail store correspondents, using ICT to promote financial inclusion in remote and underserved areas did far more than simply provide welfare benefits promptly, and their actions went unseen by many other actors in the

system. For example, engineers at a network integrator's offices were surprised when we demonstrated the position of the keypad and how clients handed over slips of paper for store owners to enter PINs. These engineers had no sense of the lack of technical "know-how" in remote and underserved areas. Banks were likewise oblivious to the correspondents' actions and the larger social role, far beyond design intentions, that these correspondents came to play.

Post Office Correspondents' Intentions and Actions

Post office clerks had no choice in the matter: they had to become correspondents by government decree. New software was added to the clerks' computers to allow clients to merge seamlessly their banking and postal transactions, including buying stamps and mailing packages:

Everything is together, I'm assisting [her] *as a postal officer with a SedEx* [express mail item]. *She comes to make a deposit, I have finished assisting* [her] *as a post office* [clerk], *I move straight to the postal bank screen to assist her as a postal bank correspondent.* (Post office correspondent)

As one of the informants noted, correspondents increased foot traffic to post offices, and clerks now had to deal with financial services as well as postal services:

It changed in the sense that I learned a lot and also [had to deal with an] *increased flow of people at the post office branch, with more services available.* (Post office correspondent)

Post office correspondents already had strong identities as public servants in a community. As correspondents, they deepened this sense of service to their public. They were not simply offering banking transactions, but taking the time to understand clients' needs and offering assistance. They contrasted their labor with that of *bancarios*:

Every city has a post office, so people who before didn't have the means to open an account, people who were afraid of walking into a bank, people from the rural zone [now have someplace to go]….*What do I like the most? It's to be able to help these people. We often show how to type a password, because of the difficulty for* [clients] *to do it. I read about the difficulty that elderly people have using the automated system* [at the bank]. *Not here—one doesn't need to go to the automated system—we assist.* (Post office correspondent)

The role of post office clerks in the community did not greatly change when they became correspondents. Rather, they expanded their commitment to public service, which now included banking. Thus they readily "*showed how to type a password*," and proactively ensured that clients such as the elderly did not need to interact with "*the automated system*." Post office correspondents did not merely type passwords, but answered questions, made clients comfortable, and reassured and welcomed clients. These correspondents maintained the feeling that they must serve the clients, not the bank:

> *When we started with the post office, we didn't think about being a bank's correspondent. We knew that we needed to give the best service on the correspondent side. However, we don't forget that we have been a postal worker longer and first.* (Post office clerk)

Post office clerks faithfully mediated the banking system for clients through their actions, but they were unlikely to become advisors in personal or financial matters like retail store owners. In part, they may have been less compelled to do so because they did not distribute welfare benefit payments. As a result, post office correspondents did not serve the poorest segment of the population as retail store correspondents did, and thus were not exposed to the same number and types of troubles that this population faced. Also, because post office correspondents worked in a large institution, they had less leeway to violate bank policies to aid clients (such as working around cash limits by using their own bank accounts, as retail store correspondents did) and less authority to work with banks to offer new services.

Comparison of Retail Store and Post Office Correspondents

The Brazilian correspondent banking system left a wide gap between anticipated and actual use. By design, poor or under-served clients would receive benefits, pay bills, and conduct banking transactions by operating a keypad and a card reader. The correspondent would complete the transaction via the system's POS or PC interface: selecting transaction type, noting amounts, scanning documents, handling cash, and providing a receipt. In reality, the system did not facilitate even this simple division of labor, with correspondents having to enter passcodes for many clients. But the gap was far wider still, in part because the design envisioned a transaction-based system whereas clients often needed a query-based system. Clients did not come to retail store correspondents, for example, simply with bills to pay; they came with questions about how to bank, how to settle property disputes, and how

to deal with banks and government agencies. Nothing in the ICT artifact or its supporting ICT infrastructure aided correspondents in fulfilling these client requests. Through their system appropriations, as reflected in their actions, correspondents filled this gap between what the ICT permitted and what the system needed to function.

Table 2 summarizes correspondents' intentions and actions by noting their enrollment, actions, rewards and incentives, and constraints. In each setting, for the system to work, correspondents had to appropriate the system. The type and degree of actions they took, however, differed by their setting. Most notably, the actions that retail store correspondents took appeared more expansive and substantive than the more limited actions taken by post office correspondents. For example, retail store correspondents mediated between institutions and clients and counseled clients on personal matters. By contrast, post office correspondents only marginally acted by assisting clients with the keypads and answering questions.

Table 3 demonstrates what types of appropriations were made by different actors to various elements in the correspondent banking system. Actors appropriated five key system elements—the technology, the structure of their roles, the definition of what it meant to be a user, the social dynamics of their local contexts, and the banking system's policies—to aid implementation. For example, counseling clients on personal matters (fourth row of Table 3) was an appropriation of the social dynamic of the retail store setting, one that postal clerks could not manage in their more bureaucratic setting.

What compelled actors to make these appropriations? With a rigid IT artifact that for security reasons precluded user alterations, correspondents had little opportunity to tinker with software, and the mundane acts they carried out through the POS or PC interface—such as selecting transaction types and entering monetary amounts—provided little ability to actively appropriate the features of the IT artifact. But what correspondents could and did do was to devise tactics to bypass constraints of the larger correspondent banking system, as in the case of evading bank cash limit policies and entering client passwords into POS terminals. By all accounts, correspondents in both retail stores and in post offices did not feel comfortable making these system appropriations (*"I was a little afraid that I could be doing this wrong"*). But they made them anyway because they said they could not stand to see clients angry when service was withheld, and they spoke of their nervousness in violating bank policies. Our study highlights two types of rewards and incentives—social and financial—that prompted correspondents and other actors to act in ways that allowed needed appropriations for the system to function.

Table 2. Comparison of Correspondent Banking across Two Settings

Services	Retail Store Setting	Post Office Setting
Enrollment	Voluntary	Mandatory
Actions	• Assisted with keypads • Provided financial advice • Worked around cash limit policies • Mediated between institutions and clients • Counseled clients on personal matters	• Assisted with keypads • Answered client questions • Took time with clients
Rewards and incentives for action	• Aiding local people, their clients • Store revenue • Appeal to pride • Role as public figure • Community status and recognition	• Aiding local people, their clients
Constraints on action	• Bank and government policies	• Bank and government policies • Bureaucratic structure

Table 3. Types and Exemplars of System Appropriations and the Actors Who Made Them

Type of Appropriation	Exemplar (Actor)
Technical Appropriation	• Making system work despite computer reboot delays (post office correspondents)
Role Appropriation	• Helping elderly clients bypass the automated system (post office correspondents) • Attending to wealthy clients, not poor ones (*bancarios*) • Providing financial advice (retail store correspondents)
Usage Appropriation	• Using keypad for the client (retail store and post office correspondents)
Social Appropriation	• Counseling clients on personal matters (retail store correspondent) • Welcoming clients who fear banks (post office correspondent)
Policy Appropriations	• Evading cash limit policies (retail store correspondents)

Correspondents displayed a *social* connection to their communities, a connection no doubt made stronger by living among their clients and having frequent face-to-face contact with them. Being copresent with clients and witnessing their distress lent correspondents a firsthand understanding of how their actions would benefit clients. Post office correspondents perhaps exhibited this connection to clients most clearly: they already viewed themselves as public servants and extended this vision to their correspondent duties. But retail store clerks, who were first and foremost business people, also came to see themselves as *de facto* public servants who gained recognition in the community for their actions, which appeared to reinforce their actions. For store owners, however, the potential to increase store revenue proved a prime *financial* motivator and propelled retailers to take actions to make the system work. Increased revenues did not occur at post offices by virtue of being correspondents (mail volume did not increase substantially with the added traffic of

banking clients), although the Postal Company itself made a large profit in its deal with the partner bank.

Discussion

In this paper, we extended the research lens beyond complex implementations of IT artifacts, often the primary concern of IS scholars, to the implementation of complex systems in which IT artifacts are but one element. In addition to the IT artifact (the card and barcode readers, connected to the POS/PC interface), the Brazilian correspondent banking system featured specified roles for actors, government mandates for banking reform, banking policies, and other critical elements. IS scholars are sensitive to the socio-cultural and institutional context of system implementation (Orlikowski and Iacono 2001). Yet, even scholars who acknowledge that

IT artifacts are embedded in a social environment whose characteristics influence their use, they typically conceptualize IT artifacts as existing independently from their social and institutional environments (for more discussion see, Contractor et al. 2011). By envisioning IT artifacts as interdependent elements in a larger system, rather than as exogenous forces on systems that predate the arrival of the technology, we increase the possibility for novel theorizing.

For example, our study showed how appropriations were not confined to the IT artifact. Instead, as Table 3 shows, multiple actors appropriated their roles, designers' expectations for system usage, social norms, and banking policies to make the system work. In formulating adaptive structuration theory, DeSanctis and Poole (1994) theorized that users could appropriate the technology itself, the norms of the group, or the users' organizational environment. But their own empirical data (Poole and DeSanctis 1992), along with those of others (Gopal and Prasad 2000; Zigurs and Buckland 1998), showed users typically appropriated the IT artifact, and not much more. Majchrzak et al. (2000) expanded this idea to show that users could and often did appropriate multiple elements of their environment at different times depending upon their needs. But these appropriations were sequential: users appropriated one element at one time and then another element later. The findings of our study go further by showing multiplex appropriation: the appropriation of multiple elements by multiple actors in multiple settings at the same time.

Why was multiplex appropriation necessary? Strategies to promote implementation success typically include user training (so users might better operate the system), user input into design (so designers might better craft the system for use), and user alterations (so users might better fit the system to use) (e.g., Jasperson et al. 2005; Markus and Mao 2004). These strategies often rest on the implicit premise that a gap between how designers envisioned system use and how users experienced the system begets failure (Heeks 2002). Narrowing the gap between designers' visions and users' experience thus becomes the goal in many system efforts. But in a complex system like the correspondent banking system, "users" of a system may expand in unexpected ways to form a whole so diverse as to be incompletely definable at the time of system development. Moreover, different settings are likely to shape patterns of use because actors will differ in their experience of which system elements are acceptable and which need appropriation. Across the system, multiple actors in multiple settings will appropriate multiple elements in different ways such that the system is dynamic. In other words, the set of appropriations made in one setting may not be exactly the same set of appropriations made in other settings. If appropriations are what constitute a system in practice

(Orlikowski 2000), then the same global system (here the correspondent banking system) can have various enactments occurring at the same time in different places.

Unlike much prior IS research that suggests that appropriations will eventually result in a stabilized system over time (e.g., actors will eventually use the system in the same way as each other), our findings suggest that a complex system may remain dynamic (e.g., actors will use the system in different ways than other actors). Dynamism is characteristic of complex systems (Eisenhardt and Bhatia 2002). Thus, rather than conceptualize effective implementation as closing the gap between designers' visions and users' experience, our study suggests that IS scholars would benefit from examining how complex systems can be maintained in a state of dynamism. Allowing multiplex appropriation and its attendant dynamics might foster success better than would attempts to stamp out variance through design because it allows for local alignments of system elements that fit the local contexts in which use occurs, rather than trying to force a global alignment among elements.

If complex systems require multiplex appropriation for their success, how might designers motivate actors to do such work? In our study, social and financial rewards and incentives encouraged actors to appropriate system elements. With the exception of increased store revenue for retail store correspondents and working with mostly wealthy clients in the case of *bancarios*, the rewards and incentives in our study were primarily social. Studies show that identification with and obligation to a system's community may prompt people to act (e.g., Lakhani and Wolf 2005). Correspondents in our study lived and worked in the same community as their clients, and their interaction with clients was face to face. This intense awareness of one another and the transparency of the problems that beset clients may have been important in shaping our results by assuring the correspondents' affective connection to the community (Grant 2007). Indeed, social dependence on the beneficiary and friendship with the beneficiary may influence people's decision to help others (Grant 2007; McNeely and Meglino 1994). Many IS theories discuss the importance of identifying incentives for system use in advance of implementation. In the case of complex systems, our findings suggest that encouraging multiple actors to develop their own socially based incentives may be the best avenue for ensuring effective implementation.

Finally, our findings suggest that a system's intended users are not its only important appropriators. In the correspondent banking system, multiple actors, most prominently retail store owners and postal clerks, needed to appropriate system elements in their own local settings to keep the system running for its intended users (clients). Although we did not interview

clients directly, which is certainly a limitation of this study, we know that clients barely touched the IT artifact and never appropriated system elements. Rather, correspondents mediated clients' use of the system. This model of technology mediation is distinct from other discussions of mediators in the IS literature that depict mediators as champions or power-users who model effective use and sanction users who are not behaving appropriately (Orlikowski et al. 1995; Volkoff et al. 2007). Instead, our study reveals mediators who acted as surrogates, using the system on behalf of clients in their setting. Because the settings were so diverse, these mediators appropriated system elements in different ways. Thus, when we look at the system as a whole, it might be more appropriate to say that mediators' appropriations created multiple versions of the same correspondent banking system that existed at the same time because each local set of appropriations constituted a slightly different version of the global system. By design or by luck, the policies governing the correspondent banking system, the roles specified by system designers, and the IT artifact used to make the system work were loosely enough configured that the correspondent banking system as a whole could absorb the shock of multiple enactments of the same system simultaneously, in much the same way that Berente and Yoo (2012), describe how the loosely configured routines in place at NASA helped to absorb the shock of ERP implementation. Thus, IS researchers can take from these findings a renewed energy to examine how systems can be designed to sustain multiple versions simultaneously through multiplex appropriation.

Conclusion

Complex societal challenges often involve large numbers of users in multiple settings with varied needs, such that tailoring systems to meet user requirements may prove impossible (Heeks 2002). Moreover, these users may not be skilled in technology use, suggesting that user training may prove too expensive to be viable and that user alterations may be unlikely (Lee 2001). Our findings suggest that in such cases, system implementation may be most successful when users are motivated to appropriate system elements in ways that make the system work for those in social need. Conceptualizing systems as dynamic entities with multiple enactments of elements through distinct appropriations can help to create the types of systems that will thrive in complex environments.

Our findings show that current IS theory is not well equipped to explain how system implementation can be successful when users of a system are so diverse as to be incompletely definable at the time of system development or when the

system's intended users are not, in practice, the users of the IT artifact. Our data suggest that a good strategy for using ICTs to combat complex societal challenges such as financial inclusion may be to assure that designers and implementers do not hold the reins too tightly. Instead, designing systems that multiple actors can appropriate, and creating incentives for them to make appropriations, may be a path to success. The codesign of dynamic complex systems with their associated rewards and incentives to encourage multiplex appropriation is an area that IS scholars have largely overlooked (Leonardi and Barley 2010), but one which the study of ICT for the amelioration of social problems suggests might be an exciting new area for theory and research.

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